3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MRID# and Title:	MR054L ISS Potable Water Quality Monitoring
Sponsor:	Medical Operations
Discipline:	Environmental Health
Category:	Medical Requirements
References:	ISS Medical Operations Requirements Document SSP 50260
Purpose/Objectives:	To monitor the quality of the potable water that is provided for crew use on ISS and determine compliance to the existing acceptability limits established for ISS water as specified in SSP 50260 ISS MORD and SSP 41000 System Specification for ISS.
Measurement Parameters:	Preflight: • For extensive list see The Fluid Procurement and Use Control Specification Document, SE-S-0073; Tables 63-6 & 64-6 In-flight: • From Russian Segment: Total organic carbon, total inorganic carbon, total carbon, conductivity, pH • From U.S. Segment: Total organic carbon, total inorganic carbon, total carbon, conductivity, pH, turbidity, color, iodine, iodide, and iodine compounds Postflight: • For extensive list see Table 5.2-1 Water Quality Requirements for the ISS Russian Segment in SSP 50260 and Table XXXII Water Quality Requirements for the U.S. On-Orbit Segment in SSP 41000.
Deliverables:	• Preflight evaluation of chemical content of potable water verifying that system-servicing procedures are properly performed • In-flight assessment of potable water samples • Postflight analyses report of archival potable water samples collected from the Russian and U.S On-Orbit Segments
Flight Duration:	≥ 30 days
Number of Flights:	6A & subs
Number and Type of Crew Members Required:	One crewmember as operator
Other Flight Characteristics:	N/A

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity Description:	Training includes the procedure for the collection and chemical analysis of water. The collection, processing, analysis, data entry, and proper stowage is demonstrated and, if possible, performed by crewmembers (CM). The in-flight collection schedule is reviewed. One crewmember is trained as the primary operator.				
Schedule:	**Duration:**		**Schedule:**	**Flexibility:**	**Personnel Required:**
	EHS Water Operations (Inexperienced CM)	90 min	L-7 months	N/A	Crewmembers/Instructors
	-Or-				
	EHS Water Operations Exp (Experienced CM)	60 min	L-7 months	N/A	Crewmembers/ Instructors
	EHS Preventive & Corrective Maintenance	60 min	L-4 months	N/A	Crewmembers/ Instructors
Ground Support Requirements Hardware/Software	**Preflight Hardware:**		**Preflight Software:**		**Test Location:**
	Total Organic Carbon Analyzer (TOCA) Water Sample Collection Kit (WSCK) TOCA Supply Kit Medical Equipment Computer (MEC)		TOCA software		U.S.
Training Facilities	**Minimum Room Dimensions:**	**Number of Electrical Outlets:**	**Temperature Requirements:**		**Special Lighting:**
	8' x 10'	2 110V	Ambient		None
	Hot or Cold Running Water:	**Privacy Requirements:**	**Other:**		
	None	N/A	Table & 4-6 chairs 28V Power supply		
Constraints/Special Requirements:	None				
Launch Delay Requirements:	▪ Refresher training will be conducted at crewmember request. ▪ The ISS Training Manual defines the training format for Experienced crewmembers.				
Notes:	Experienced crewmembers – those crewmembers who have had previous training within the last 1½ yrs				

3.4 Preflight Activities – No Crew time

TABLE 3.4: PREFLIGHT ACTIVITIES

<table>
<tr><td rowspan="3">Preflight Activity
Description:</td><td colspan="5">U.S. and Russian Ground Supplied Water: Prior to launch water samples are collected during preparation of the water systems for flight, and are tested to establish whether ground-supplied potable water to the Shuttle is within specified acceptability limits. These data are used to verify that system-servicing procedures were properly performed and that the water transferred to ISS is safe for crew consumption. NASA- and RSA-approved laboratories using standard methods or EPA procedures analyze the water. No crew time required.</td></tr>
<tr><td>Schedule:</td><td>Duration:</td><td colspan="2">Schedule:</td><td>Flexibility:</td><td>Personnel Required:</td></tr>
<tr><td></td><td>Collection of water samples - approx 2 hrs per session</td><td colspan="2">U.S. Supplied Water:
At time of Servicing,
L-15 days,
L-3 days</td><td>N/A</td><td>KSC/JSC Personnel</td></tr>
<tr><td></td><td>Collection of water samples - approx 2 hrs per session</td><td colspan="2">Russian Supplied Water:
At time of Servicing,
Before Launch</td><td>N/A</td><td>RSA/IBMP Personnel</td></tr>
<tr><td rowspan="2">Ground Support Requirements Hardware/Software</td><td>Preflight Hardware:</td><td colspan="2">Preflight Software:</td><td colspan="2">Test Location:</td></tr>
<tr><td>Ground Servicing Equipment</td><td colspan="2">None</td><td colspan="2">U.S. and Russia</td></tr>
<tr><td rowspan="4">Testing Facilities</td><td>Minimum Room Dimensions:</td><td>Number of Electrical Outlets:</td><td>Temperature Requirements:</td><td colspan="2">Special Lighting:</td></tr>
<tr><td>10' x 15'</td><td>4 110V</td><td>Ambient</td><td colspan="2">N/A</td></tr>
<tr><td>Hot or Cold Running Water:</td><td>Privacy Requirements:</td><td>Vibration/Acoustic Isolation:</td><td colspan="2">Other:</td></tr>
<tr><td>N/A</td><td>None</td><td>N/A</td><td colspan="2">N/A</td></tr>
<tr><td>Constraints/Special Requirements:</td><td colspan="5">▪ KSC and RSA personnel collect all preflight water samples in U.S. and Russia, respectively.
▪ JSC/KSC and RSA/IBMP laboratories analyze post-Service samples in U.S. and Russia respectively.
▪ Remediation actions will be taken if water samples exceed specified limits. Repeat samples will be taken and/or servicing will be repeated.</td></tr>
<tr><td>Launch Delay Requirements:</td><td colspan="5">▪ Repeat Shuttle L-3 sampling if launch is delayed beyond 3 days
▪ Perform preflight potable water sampling every 90 days if launch delayed.</td></tr>
<tr><td>Notes:</td><td colspan="5">None</td></tr>
<tr><td>Data Delivery</td><td colspan="5">Data/Report to Designated Recipients (Nominal/Contingency):
• KSC will provide preflight sample reports, including chemical and microbiology results, to JSC as soon as the reports are available.
• JSC Water Laboratory (WAFAL – Water and Food Analytical Laboratory) will then provide a report to the Flight Surgeon and BME within the same day upon receipt of KSC reports for L-3 days sample and within 3 days upon receipt of KSC reports for all other samples.
• RSA/IBMP will provide preflight sample results to the Environmental Health Subgroup of the MMOP as soon as they are available.</td></tr>
</table>

3.5 In-Flight Activities

TABLE 3.5.1: IN-FLIGHT ACTIVITIES

In-Flight Activity **Description:**	In-flight water quality monitoring activities include the collection of water samples from the Russian water systems located in the Service Module throughout the life of the ISS, and eventually from the U.S. water reclamation system. Samples collected include archive samples for postflight detailed chemical analysis, as well as samples for in-flight analysis using the Total Organic Carbon Analyzer (TOCA). The TOCA is used to determine concentrations of total organic carbon, total inorganic carbon, total carbon, pH, and conductivity in ISS water samples. The information generated from both the in-flight and ground analyses is used to assess the quality of the water supply and its suitability for crew consumption.			
Schedule:	**Activity:**	**Duration:**	**Schedule:**	**Personnel Required:**
	Potable Water Collection for Chemical – In-flight Chemical – Archive	Unstow 15 min SRV-K heating cycle 20 min/525mL Flush 5 min/flush Sample collection 10 min/sample Stow 15 min	Follow schedule according to Tables 5.2-2 & 5.2-3 ISS Russian Segment Water Sampling & Analysis Schedule, ISS MORD The SVO-ZV samples can be taken during any of the 20-min heating cycles. Each heating cycle for the SRV-K port can only allow a maximum of 525mL of water to be collected. Additional heating cycles are needed if the total volume of water taken at the SRV-K port exceeds 525mL. Number of samples to be collected is specified in the Daily Execute Note to be submitted one week prior to the schedule activity.	1 ECLSS CM
	TOCA Activation & Checkout	65 min crew time + 50 min unattended Includes: Unstow/setup of TOCA/MEC 20 min Initiate test sample analysis 10 min Unattended 50 min Terminate analysis 10 min Call down results 5 min Tear down/stow 20 min	One time – prior to first TOCA analysis session; 1-2 weeks post H/W arrival (as early as possible)	1 ECLSS CM

TABLE 3.5.1: IN-FLIGHT ACTIVITIES (Cont'd)

Schedule:	Activity:	Duration:	Schedule:	Personnel Required:
	TOCA Chemical Analysis	2:10 hrs crew time + 2 hrs unattended Includes: Unstow/setup TOCA/MEC 20 min Fill/start 1st sample syringe 20 min Unattended 50 min Calldown 5 min End 1st sample syringe 10 min Fill/start 2nd sample syringe 20 min Unattended 50 min Calldown 5 min End 2nd sample syringe 10 min Start DI flush 5 min Unattended 20 min End DI flush 5 min Teardown/stow 30 min	Following each in-flight chemical water sampling session where TOCA samples are collected but not later than one week after sampling See Table 5.2-2 ISS Russian Segment Water Sampling & Analysis Schedule, ISS MORD	1 ECLSS CM
	TOCA Waste Container Replacement	70 min crew time Includes: Unstow/Setup 20 min Replacement 30 min Teardown/Stow 20 min	After every 500 ml of waste collected (or as instructed by MCC)	1 ECLSS CM
	TOCA RAM Card Replacement	55 min crew time Includes: Unstow/Setup 20 min Card Replacement 15 min Teardown/Stow 20 min	As needed; contingency only	1 ECLSS CM

TABLE 3.5.1: IN-FLIGHT ACTIVITIES (Cont'd)

Schedule:	Activity:	Duration:	Schedule:	Personnel Required:
	TOCA Reagent Mixing	65 min crew time + 45 min unattended Includes: Unstow/Setup 20 min Mix/start flush 25 min Unattended 45 min Finish flush/stow 20 min	Once every 90 days (time starts from mixing of new reagent batch)	1 ECLSS CM
	TOCA Fuse Replacement	55 min crew time Includes: Unstow/Setup 20 min Fuse Replacement 15 min Tear Down/Stow 20 min	As needed; contingency only	1 ECLSS CM
	TOCA Calibration	80 min crew time + 100 min unattended Includes: Unstow/Setup 20 min Start syringe A 15 min Unattended 50 min End A/Start B 10 min Unattended 50 min End syringe B 10 min Call down 5 min Tear down/Stow 20 min	Once every 6 months	1 ECLSS CM

TABLE 3.5.1: IN-FLIGHT ACTIVITIES (Cont'd)

Schedule:	Activity:	Duration:	Schedule:	Personnel
	TOCA Data Download to MEC	70 min crew time Includes: Unstow/Setup 20 min Download 30 min Teardown/Stow 20 min	Contingency – necessary in the event of a solar event, which may damage the RAM card. As needed – downloaded data may be used for troubleshooting.	1 ECLSS CM 1 ECLSS CM
	TOCA Contaminant Cleanup	60 min crew time Includes: Clean-up Activity 60 min	As needed; contingency only	
	TOCA Isolation for Ground Return of Hardware in Case of Leakage	60 min crew time Includes: Isolation of TOCA 60 min	As needed; contingency only	1 ECLSS CM
	TOCA Test Sample Syringe Analysis Malfunction	65 min crew time + 50 min unattended Includes: Unstow/setup of TOCA/MEC 20 min Initiate test sample analysis 10 min Unattended 50 min Terminate analysis 10 min Call down results 5 min Tear down/stow 20 min	As needed; contingency only	1 ECLSS CM

TABLE 3.5.1: IN-FLIGHT ACTIVITIES (Cont'd)

Schedule:	Activity:	Duration:	Schedule:	Personnel Required:
	Photos	5-10 minutes/photo	**Water Collection:** Photo documentation is required during a contingency situation. **TOCA:** Photo documentation is required during a contingency situation.	1 CM
Procedures:	Water collection procedures are located in the Russian Operation Data File (RODF): • 2.1.12.4 Water Sampling from Potable Water Container using U.S. Water Samplers • 2.1.12.6 Water Sampling from EDV using U.S. Water Sampler TOCA activity procedures are located in the Systems Operation Data File (SODF) Med Ops book: • TOCA Activation and C/O • TOCA Water Sample Analysis • TOCA Waste Container Replacement • TOCA RAM Data Card Replacement • TOCA Reagent Mixing • TOCA Fuse Replacement • TOCA Calibration • TOCA Data Download to MEC • TOCA Test Sample Analysis • TOCA Contaminant Cleanup • TOCA Isolation for Ground Return of H/W in Case of Leakage • TOCA Error and Diagnostics Malfunction • TOCA Low Pressure Detected in Sample Line – Error 46 • TOCA Sample Syringe May Contain Too Little Water – Warning 51			

TABLE 3.5.1: IN-FLIGHT ACTIVITIES (Cont'd)

Constraints / Special Requirements:	Potable Water Collection • Only 1 flush is required/port for multiple sampling • When chemical samples are collected in conjunction with micro samples, only 15 min of unstow time & 15 min of stow time is required • Chemical & micro water collection to be done in same session • Collected from SRV-K & SVO-ZV • Archive samples from SRV-K require 2 portions • Schedule so there is no interference with meals TOCA Activation & Checkout • Results called down TOCA Chemical Analysis • Logbook entry after each analysis. • Call-down results after each analysis • TOCA requires 50 min unattended/sample if sample introduced from a sample syringe. • Off-nominal: TOCA requires 80 min unattended/sample if sample introduced from a sample bag • A 20 min flush may be required prior to shutdown. TOCA Waste Container Replacement • TOCA will give warning message when replacement required TOCA Reagent Mixing • TOCA will give warning message when mixing required TOCA Calibration • Requires two 50 min unattended periods (for 2 syringe analyses) TOCA Isolation for Ground Return of Hardware in Case of Leakage • Call down upon completion TOCA Test Sample Syringe Analysis • Data – call down results Photos • TOCA deployment – photo to be taken at a medium distance • Chemical Archive Sampling – photo to be taken 3-4 ft from activity to include everything • TOCA analyses – close-up photo of the sample interface & syringe analysis • Contingencies – close-up photos that document problems
Photo / TV Requirements:	Photo documentation is required during contingency situations.

TABLE 3.5.1: IN-FLIGHT ACTIVITIES (Cont'd)

Cold Stowage Requirements:	None
Mission Extension Requirements:	None
Landing Wave-Off Requirements:	N/A
Notes:	Real-time changes to the U.S. In-flight Water Quality sampling schedule considering flight necessities and water systems operability will be made based upon JSC water quality team recommendations.
Data Delivery:	**Data/Report to Designated Recipients (Nominal/Contingency):**
	• Call-down data is logged by the BME then sent to the Crew Surgeon and to the JSC Water Laboratory (WAFAL – Water and Food Analytical Laboratory - Water Laboratory Lead and Flight Hardware Engineer), who then interpret data and forward to MMOP Environmental Health Working Group (including International Partners). • Downlinked data file from MEC is forwarded to JSC Water Laboratory upon receipt. A report is sent to the BME and crew surgeon within 2 weeks of receipt of downlinked data file.

TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name	P/N
Total Organic Carbon Analyzer (TOCA)	SEG46113546-XXX
TOCA Supply Kit	SEG46116007-XXX
Water Sample Collection Kit (WSCK) (Shared with MR051L)	SEG46119987-XXX
Medical Equipment Computer (MEC)	SEG46116031-XXX
TOCA Data Entry Software	N/A (uses Windows Hyperterminal program)

3.5 Postflight Activities – No Crew time

TABLE 3.6: POSTFLIGHT ACTIVITIES

Postflight Activity Description:	Destow and return of samples to JSC: Comprehensive chemical analyses are performed on returned archive water samples at JSC WAFAL Laboratory or RSA/IBMP. No crew time.				
Schedule:	**Duration:**	**Schedule:**	**Flexibility:**	**Personnel Required:**	
	Early destow of water samples within 3 hrs of landing	Early return of samples to JSC within 48 hrs after landing	N/A	KSC/JSC Personnel	
Ground Support Requirements Hardware/Software	**Postflight Hardware:**	**Postflight Software:**	**Test Location:**		
	N/A	N/A	U.S./Russia		
Testing Facilities	**Minimum Room Dimensions:**	**Number of Electrical Outlets:**	**Temperature Requirements:**	**Special Lighting:**	
	20' x 15'	4 110V	65 to 80º F	N/A	
	Hot or Cold Running Water:	**Privacy Requirements:**	**Vibration/Acoustic Isolation:**	**Other:**	
	Yes	None	N/A	N/A	
Constraints/Special Requirements:	Returned water samples should be placed on ice for transport to JSC for sample processing within 48 hrs after landing.				
Early Destow / Early Return:	All archived water samples should be unloaded from Shuttle at R+3 hours for return to JSC for analysis in WAFAL.				
Notes:	N/A				
Data Delivery	**Data/Report to Designated Recipients (Nominal/Contingency):**	**Mission Summary Report:**	**Data Archives:**		
	• If the analysis of ISS water indicates an elevation of a significant contaminant(s) or suspicious trend, then WAFAL will notify the Contingency Action Team, which includes the ISS Lead Surgeon. • A preliminary report will be provided within 1 week of the receipt of water samples following a contingency event (including, but not limited to, crew symptoms).	A final report including assessment of water quality on ISS will be distributed to the MMOP Environmental Health Working Group, which includes the Flight Surgeons and BMEs, and posted in the Mission Evaluation Room (MER) environmental folder no later than 3 months after the return of the samples.	All reports will be archived electronically on the WAFAL server with regularly scheduled data back-ups.		

3.6 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training				
EHS Water Operations (Inexperienced CM) -Or- EHS Water Operations (Experienced CM) EHS Preventive & Corrective Maintenance	90 min 60 min 60 min	L-7 months L-7 months L-4 months	Crewmembers/Instructors Crewmembers/Instructors Crewmembers/Instructors	None
Preflight Activity – no crew time				
Collection of Water Samples	Approx. 2 hrs per sampling session No crew time	U.S. Supplied Water: At time of Servicing, L-15 days, L-3 days Russian Supplied Water: At time of Servicing, Before Launch	KSC/JSC personnel in U.S.; RSA/IBMP personnel in Russia	-KSC & RSA personnel collect all preflight water samples in U.S. & Russia, respectively -KSC/ JSC & RSA/IBMP laboratories analyze post-Service samples in U.S. & Russia, respectively. -Remediation actions will be taken if water samples exceed specified limits. Repeat samples will be taken and/or servicing will be repeated.

TABLE 3.7: SUMMARY SCHEDULE (Cont'd)

ACTIVITY	DURATION	SCHEDULE	PERSONNEL	CONSTRAINTS
In-Flight Activity				
Potable Water Collection for: Chemical In-flight Analysis Chemical Archive Sample	Crew time 45 min SRV-K heating cycle 20 min/525 mL	Follow schedule according to Tables 5.2-2 & 5.2-3 ISS Russian Segment Water Sampling & Analysis Schedule, ISS MORD The SVO-ZV samples can be taken during any of the 20- min heating cycles. Each heating cycle for the SRV-K port can only allow a maximum of 525mL of water to be collected. Additional heating cycles are needed if the total volume of water taken at the SRV-K port exceeds 525mL. Number of samples to be collected is specified in the Water Flight Note to be submitted one week prior to the schedules activity.	1 ECLSS CM	-Only 1 flush is required/port for multiple sampling. -When chemical samples are collected in conjunction with micro samples, only 15 min of unstow time & 15 min of stow time is required. -Chemical & micro water collection to be done in same session. -Collected from SRV-K & SVO-ZV. -Archive samples from SRV-K require two portions -Schedule so there is no interference with meals
TOCA Activation & Checkout	Crew time 65 min Unattended 50 min	One time – prior to first TOCA session; 1-2 weeks post H/W arrival (as early as possible)	1 ECLSS CM	Results called-down
TOCA Chemical Analysis	Crew time 2:10 hrs Unattended 2 hrs	Following each in-flight chemical water collection session See Table 5.2-2 ISS Russian Segment Water Sampling & Analysis Schedule, ISS MORD	1 ECLSS CM	-Logbook entry after each analysis. -Call-down results after each analysis -TOCA requires 50 min unattended/sample if sample introduced from a sample syringe. -Off-nominal: TOCA requires 80 min unattended/sample if sample introduced from a sample bag -A 20 min flush may be required prior to shutdown.

TABLE 3.7: SUMMARY SCHEDULE (Cont'd)

ACTIVITY	DURATION	SCHEDULE	PERSONNEL	CONSTRAINTS
In-Flight Activity				
TOCA Waste Container Replacement	70 min	After every 500 ml of waste collected (approximately every 25 syringe analyses)	1 ECLSS CM	TOCA will give warning message when replacement is required.
TOCA RAM Card Replacement	55 min	As needed, contingency only	1 ECLSS CM	None
TOCA Reagent Mixing	Crew time 65 min Unattended 45 min	Once every 90 days (time starts from mixing of new reagent batch)	1 ECLSS CM	TOCA will give warning message when reagent mixing is required.
TOCA Fuse Replacement	55 min	As needed, contingency only	1 ECLSS CM	None
TOCA Calibration	Crew time 80 min Unattended 100 min	Once every 6 months	1 ECLSS CM	Requires two 50 min unattended periods (for 2 syringe analyses).
TOCA Data Download to MEC	70 min	Contingency – necessary in the event of a solar event, which may damage the RAM card. As needed – downloaded data may be used for troubleshooting.	1 ECLSS CM	None
TOCA Contaminant Clean-up	60 min	As needed, contingency only	1 ECLSS CM	None
TOCA Isolation for Ground Return of Hardware in Case of Leakage	60 min	As needed; contingency only	1 ECLSS CM	Call down upon completion
TOCA Test Sample Syringe Analysis Malfunction	Crew time 65 min Unattended 50 min	As needed; contingency only	1 ECLSS CM	Data: Call down results

TABLE 3.7: SUMMARY SCHEDULE (Cont'd)

ACTIVITY	DURATION	SCHEDULE	PERSONNEL	CONSTRAINTS
In-Flight Activity				
Photos	5 –10 min/photo	**Water Collection:** Contingency **TOCA:** Contingency	1 operator	TOCA deployment medium distance shot Chemical archive sampling 3-4 ft from activity to include everything TOCA analyses close-up photo of the sample interface & syringe analysis Contingencies close-up photos that document problems
Wheels-Stop: N/A				
Postflight: N/A				
Postflight Debrief				
Debrief	No extra time	~R+30 days	Crewmembers/ Water Laboratory	Part of the Med Ops overall debrief.